

# NATIONAL BUREAU OF STANDARDS REPORT

8989

on  
Interlaboratory Intercomparison  
of  
100-Watt Incandescent Lamps

by  
Velma I. Burns  
Photometry and Colorimetry Section  
Metrology Division



U. S. DEPARTMENT OF COMMERCE  
NATIONAL BUREAU OF STANDARDS

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U. S. DEPARTMENT OF COMMERCE  
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Interlaboratory Intercomparison  
of  
100-Watt Incandescent Lamps

ABSTRACT

A group of twelve 100-watt incandescent lamps was measured by each of nine laboratories. The voltage across each lamp was held at 120.0 volts while the luminous flux and current were measured. The results of the measurements made by the individual laboratories and an analysis of the results are given in this report.

INTRODUCTION

This intercomparison was undertaken to determine the uniformity of measurements on 100-watt incandescent lamps made at the participating laboratories. The laboratories participating and the order of reading are as follows:

1. Duro Test
2. Westinghouse
3. Electrical Testing Laboratories
4. General Electric
5. Verd-A-Ray
6. Sylvania
7. Champion
8. El Tronics
9. National Bureau of Standards
10. Duro Test

Duro Test measured the lamps first and again at the end of the intercomparison. Both sets of measurements are reported here.

Each laboratory followed its own customary procedure in making the measurements. In each laboratory the voltage across each lamp was held constant at 120.0 volts while readings of luminous flux and current were taken.

RESULTS OF THE MEASUREMENTS

The results are reported in tables 1 through 4. The averages reported for each lamp and for each laboratory are also given. The difference,  $\Delta$ , between the average for each laboratory and the average for all the laboratories for all the lamps is also given in the tables.



## ANALYSIS OF RESULTS

An analysis of the results of the measurements has been made following a modification of the method described by W. J. Youden (1), (2), and (3). The modification is described in National Bureau of Standards Report No. 6605, Interlaboratory Intercomparisons of 32-watt T12 Cool-White Circline Lamps, and Report No. 6698, Interlaboratory Intercomparisons of 40-watt T12 Cool-White Fluorescent Lamps. The analysis is shown on the following graphs. The point representing the measurements of an individual laboratory is designated by the first or the first and second letters in the name of the laboratory. The point representing the average of all the laboratories is designated by the letter A.

- (1) Graphical Diagnosis of Interlaboratory Test Results, Industrial Quality Control, Vol. XV, No. 11, May 1959.
- (2) Product Specification and Test Procedures, Industrial and Engineering Chemistry, Vol. 50, page 914, October 1958.
- (3) Circumstances Alter Cases, Industrial and Engineering Chemistry, Vol. 50, page 77A, December 1958.





Table 1.

## Lumens

| Lamp No. | Duro T<br>1964 | West. | ETL  | GE   | VAR  | Syl  | Champ | E1 T | NBS  | Duro T<br>1965 | Average |
|----------|----------------|-------|------|------|------|------|-------|------|------|----------------|---------|
| ET - 1   | 1228           | 1237  | 1222 | 1244 | 1232 | 1234 | 1230  | 1241 | 1218 | 1210           | 1230    |
| ET - 2   | 1218           | 1240  | 1235 | 1243 | 1243 | 1224 | 1240  | 1248 | 1207 | 1220           | 1232    |
| ET - 3   | 1248           | 1264  | 1240 | 1265 | 1263 | 1259 | 1255  | 1268 | 1244 | 1245           | 1255    |
| ET - 4   | 1234           | 1246  | 1227 | 1245 | 1235 | 1230 | 1230  | 1239 | 1228 | 1219           | 1233    |
| ET - 5   | 1245           | 1260  | 1241 | 1262 | 1253 | 1250 | 1238  | 1254 | 1238 | 1234           | 1248    |
| ET - 6   | 1246           | 1251  | 1235 | 1248 | 1254 | 1236 | 1238  | 1249 | 1230 | 1223           | 1241    |
| ET - 7   | 1230           | 1241  | 1222 | 1243 | 1232 | 1232 | 1231  | 1239 | 1232 | 1218           | 1232    |
| ET - 8   | 1247           | 1248  | 1237 | 1256 | 1251 | 1241 | 1247  | 1263 | 1248 | 1233           | 1247    |
| ET - 9   | 1247           | 1255  | 1240 | 1263 | 1252 | 1247 | 1246  | 1256 | 1239 | 1240           | 1248    |
| ET -10   | 1232           | 1246  | 1227 | 1245 | 1237 | 1228 | 1234  | 1239 | 1232 | 1219           | 1234    |
| ET -11   | 1250           | 1246  | 1224 | 1247 | 1248 | 1240 | 1248  | 1251 | 1229 | 1230           | 1241    |
| ET -12   | 1261           | 1260  | 1251 | 1262 | 1255 | 1247 | 1260  | 1249 | 1241 | 1230           | 1252    |
| Ave      | 1241           | 1250  | 1233 | 1252 | 1246 | 1239 | 1241  | 1250 | 1232 | 1227           | 1241    |
| Δ        | 0              | + 9   | - 8  | + 11 | + 5  | - 2  | 0     | + 9  | - 9  | - 14           |         |
| %Δ       | 0              | .73   | .64  | .89  | .40  | .16  | 0     | .73  | .73  | 1.13           |         |



Table 2.

Amperes

| Lamp No.   | Duro T<br>1964 | West.   | ETL    | GE      | VAR     | Syl    | Champ   | El T   | NBS    | Duro T<br>1965 | Ave   |
|------------|----------------|---------|--------|---------|---------|--------|---------|--------|--------|----------------|-------|
| ET - 1     | .821           | .822    | .820   | .8226   | .821    | .821   | .821    | .8215  | .8203  | .821           | .8211 |
| ET - 2     | .822           | .824    | .824   | .8242   | .823    | .822   | .824    | .8236  | .8206  | .822           | .8229 |
| ET - 3     | .830           | .832    | .829   | .8313   | .831    | .832   | .831    | .8317  | .8308  | .832           | .8311 |
| ET - 4     | .820           | .820    | .818   | .8189   | .820    | .818   | .819    | .8179  | .8184  | .819           | .8189 |
| ET - 5     | .827           | .828    | .825   | .8268   | .828    | .826   | .825    | .8256  | .8254  | .824           | .8261 |
| ET - 6     | .823           | .825    | .822   | .8233   | .822    | .821   | .824    | .8223  | .8225  | .823           | .8228 |
| ET - 7     | .829           | .829    | .826   | .8281   | .829    | .827   | .828    | .8274  | .8285  | .829           | .8281 |
| ET - 8     | .828           | .828    | .826   | .8280   | .828    | .826   | .828    | .8282  | .8286  | .829           | .8278 |
| ET - 9     | .822           | .824    | .822   | .8236   | .822    | .822   | .823    | .8220  | .8220  | .822           | .8225 |
| ET - 10    | .821           | .822    | .820   | .8207   | .821    | .819   | .822    | .8197  | .8215  | .822           | .8209 |
| ET - 11    | .828           | .829    | .825   | .8273   | .828    | .826   | .829    | .8275  | .8268  | .828           | .8275 |
| ET - 12    | .829           | .828    | .827   | .8275   | .829    | .827   | .829    | .8259  | .8263  | .826           | .8275 |
| Ave        | .8250          | .8259   | .8237  | .8252   | .8252   | .8239  | .8252   | .8244  | .8243  | .8248          | .8248 |
| $\Delta$   | +0.0002        | +0.0011 | -.0011 | +0.0004 | +0.0004 | -.0009 | +0.0004 | -.0004 | -.0005 | .0000          |       |
| % $\Delta$ | .02            | .13     | .13    | .05     | .05     | .11    | .05     | .05    | .06    | 0              |       |



Table 3.

Watts

| Lamp No.   | Duro T<br>1964 | West. | ETL   | GE    | VAR   | Sy1   | Champ | El T  | NBS   | Duro T<br>1965 | Ave   |
|------------|----------------|-------|-------|-------|-------|-------|-------|-------|-------|----------------|-------|
| ET - 1     | 98.5           | 98.6  | 98.4  | 98.7  | 98.5  | 98.5  | 98.5  | 98.58 | 98.44 | 98.5           | 98.52 |
| ET - 2     | 98.6           | 98.9  | 98.9  | 98.9  | 98.8  | 98.6  | 98.9  | 98.84 | 98.47 | 98.6           | 98.75 |
| ET - 3     | 99.6           | 99.8  | 99.5  | 99.8  | 99.7  | 99.8  | 99.7  | 99.80 | 99.70 | 99.8           | 99.72 |
| ET - 4     | 98.4           | 98.4  | 98.2  | 98.3  | 98.4  | 98.2  | 98.3  | 98.15 | 98.21 | 98.3           | 98.29 |
| ET - 5     | 99.2           | 99.4  | 99.0  | 99.2  | 99.4  | 99.1  | 99.0  | 99.07 | 99.05 | 98.9           | 99.13 |
| ET - 6     | 98.8           | 99.0  | 98.6  | 98.8  | 98.6  | 98.5  | 98.9  | 98.67 | 98.70 | 98.8           | 98.74 |
| ET - 7     | 99.5           | 99.5  | 99.1  | 99.4  | 99.5  | 99.2  | 99.4  | 99.28 | 99.42 | 99.5           | 99.38 |
| ET - 8     | 99.4           | 99.4  | 99.1  | 99.4  | 99.4  | 99.1  | 99.4  | 99.38 | 99.43 | 99.5           | 99.35 |
| ET - 9     | 98.6           | 98.9  | 98.6  | 98.8  | 98.6  | 98.6  | 98.8  | 98.64 | 98.64 | 98.6           | 98.68 |
| ET - 10    | 98.5           | 98.6  | 98.4  | 98.5  | 98.5  | 98.3  | 98.7  | 98.36 | 98.58 | 98.6           | 98.50 |
| ET - 11    | 99.4           | 99.5  | 99.0  | 99.3  | 99.4  | 99.1  | 99.5  | 99.24 | 99.22 | 99.4           | 99.31 |
| ET - 12    | 99.5           | 99.4  | 99.2  | 99.3  | 99.5  | 99.2  | 99.5  | 99.11 | 99.16 | 99.1           | 99.30 |
| Ave        | 99.00          | 99.12 | 98.83 | 99.03 | 99.02 | 98.85 | 99.05 | 98.93 | 98.92 | 98.97          | 98.97 |
| $\Delta$   | + .03          | + .15 | - .14 | + .06 | + .05 | - .12 | + .08 | - .04 | - .05 | .00            |       |
| % $\Delta$ | .03            | .15   | .14   | .06   | .05   | .12   | .08   | .04   | .05   | 0              |       |



Table 4.  
Lumens per Watt

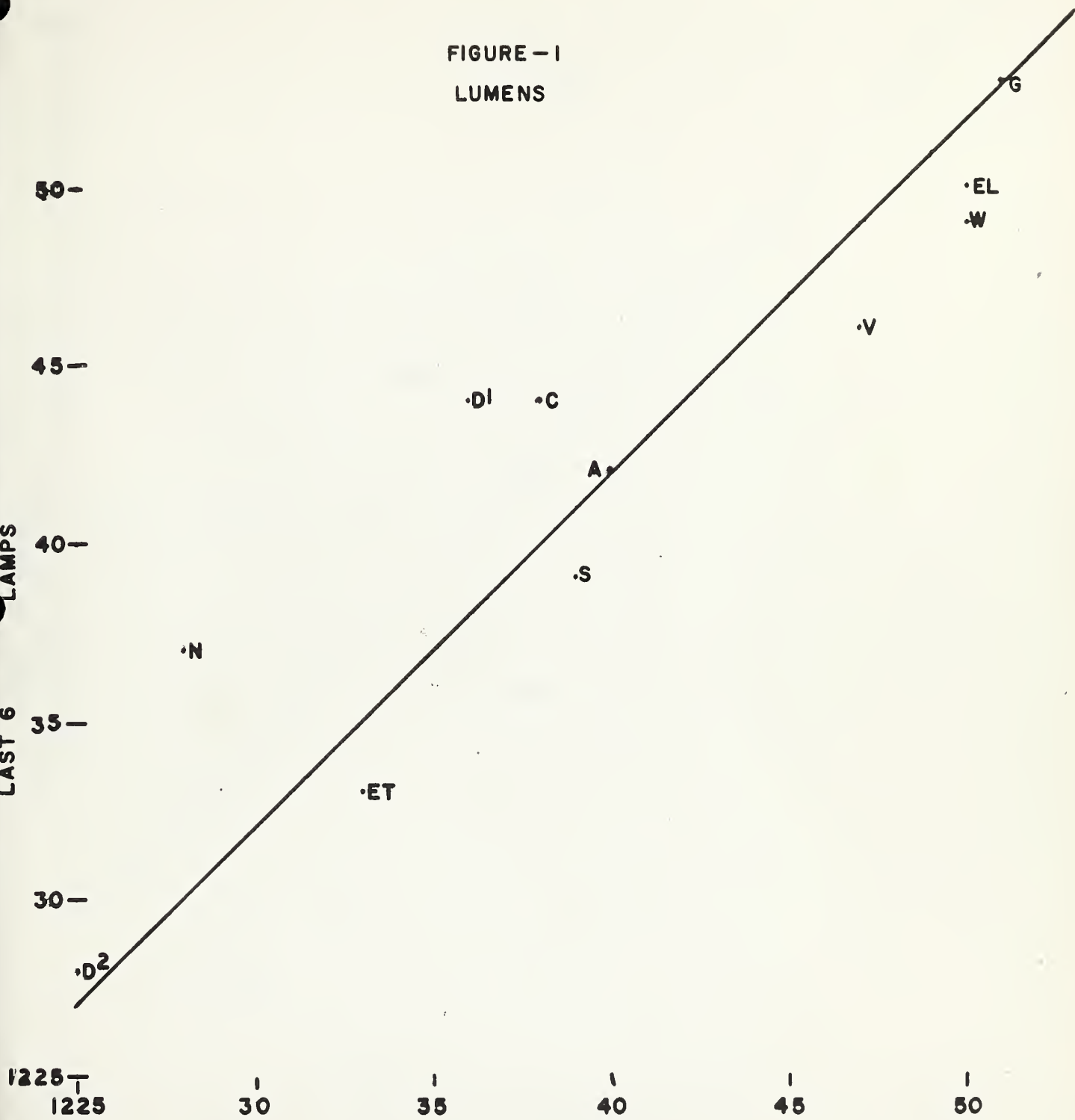
| Lamp No.   | Duro T<br>1964 | West. | ETL   | GE    | VAR   | Syl   | Champ | E1 T  | NBS   | Duro T<br>1965 | Ave   |
|------------|----------------|-------|-------|-------|-------|-------|-------|-------|-------|----------------|-------|
| ET - 1     | 12.47          | 12.55 | 12.42 | 12.60 | 12.51 | 12.53 | 12.50 | 12.59 | 12.37 | 12.28          | 12.48 |
| ET - 2     | 12.35          | 12.54 | 12.49 | 12.57 | 12.58 | 12.41 | 12.55 | 12.63 | 12.26 | 12.37          | 12.48 |
| ET - 3     | 12.53          | 12.67 | 12.46 | 12.68 | 12.67 | 12.62 | 12.59 | 12.71 | 12.48 | 12.47          | 12.59 |
| ET - 4     | 12.54          | 12.66 | 12.49 | 12.67 | 12.56 | 12.53 | 12.51 | 12.62 | 12.50 | 12.40          | 12.55 |
| ET - 5     | 12.55          | 12.68 | 12.54 | 12.72 | 12.60 | 12.61 | 12.50 | 12.65 | 12.50 | 12.49          | 12.58 |
| ET - 6     | 12.61          | 12.64 | 12.53 | 12.63 | 12.69 | 12.55 | 12.51 | 12.66 | 12.46 | 12.38          | 12.57 |
| ET - 7     | 12.36          | 12.47 | 12.33 | 12.51 | 12.38 | 12.42 | 12.40 | 12.48 | 12.39 | 12.24          | 12.40 |
| ET - 8     | 12.55          | 12.56 | 12.48 | 12.64 | 12.58 | 12.52 | 12.53 | 12.71 | 12.55 | 12.39          | 12.55 |
| ET - 9     | 12.65          | 12.69 | 12.58 | 12.78 | 12.69 | 12.65 | 12.60 | 12.74 | 12.56 | 12.57          | 12.65 |
| ET - 10    | 12.51          | 12.64 | 12.47 | 12.64 | 12.56 | 12.49 | 12.50 | 12.59 | 12.50 | 12.36          | 12.53 |
| ET - 11    | 12.58          | 12.52 | 12.36 | 12.56 | 12.55 | 12.51 | 12.52 | 12.60 | 12.39 | 12.37          | 12.50 |
| ET - 12    | 12.67          | 12.68 | 12.61 | 12.71 | 12.62 | 12.57 | 12.68 | 12.60 | 12.52 | 12.42          | 12.61 |
| Ave        | 12.53          | 12.61 | 12.48 | 12.64 | 12.58 | 12.53 | 12.53 | 12.63 | 12.46 | 12.40          | 12.54 |
| $\Delta$   | - .01          | + .07 | + .06 | + .10 | + .04 | - .01 | + .01 | + .09 | - .08 | -.14           |       |
| % $\Delta$ | .08            | .56   | .48   | .80   | .32   | .08   | .08   | .72   | .64   | 1.12           |       |





FIGURE - I  
LUMENS

LAST 6  
LAMPS



FIRST 6 LAMPS



B27-

FIGURE - 2  
AMPERES

.826-

LAST 6 LAMPS

.825-

.824-

.823

.824

.825

FIRST 6 LAMPS

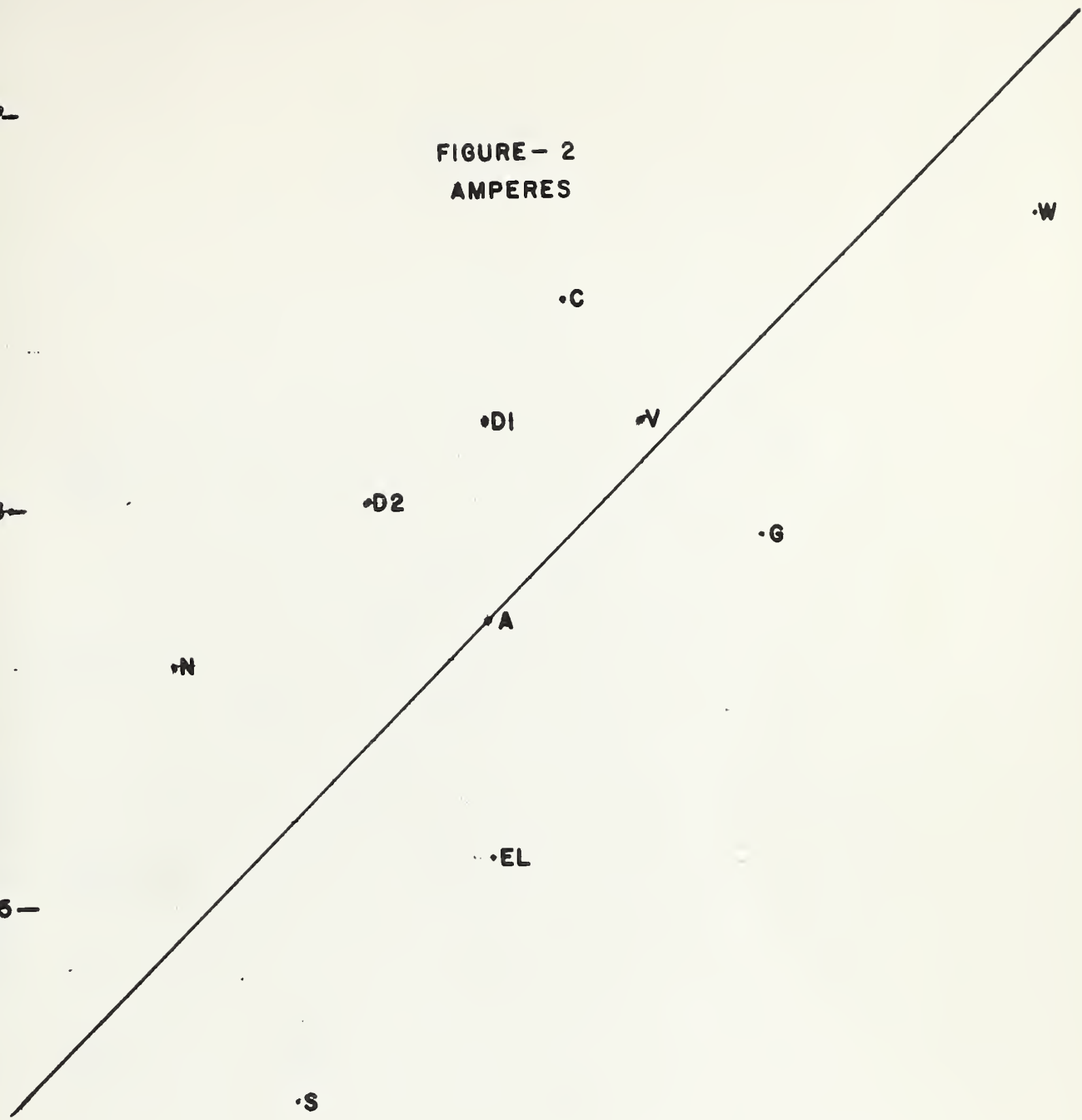




FIGURE-3  
WATTS

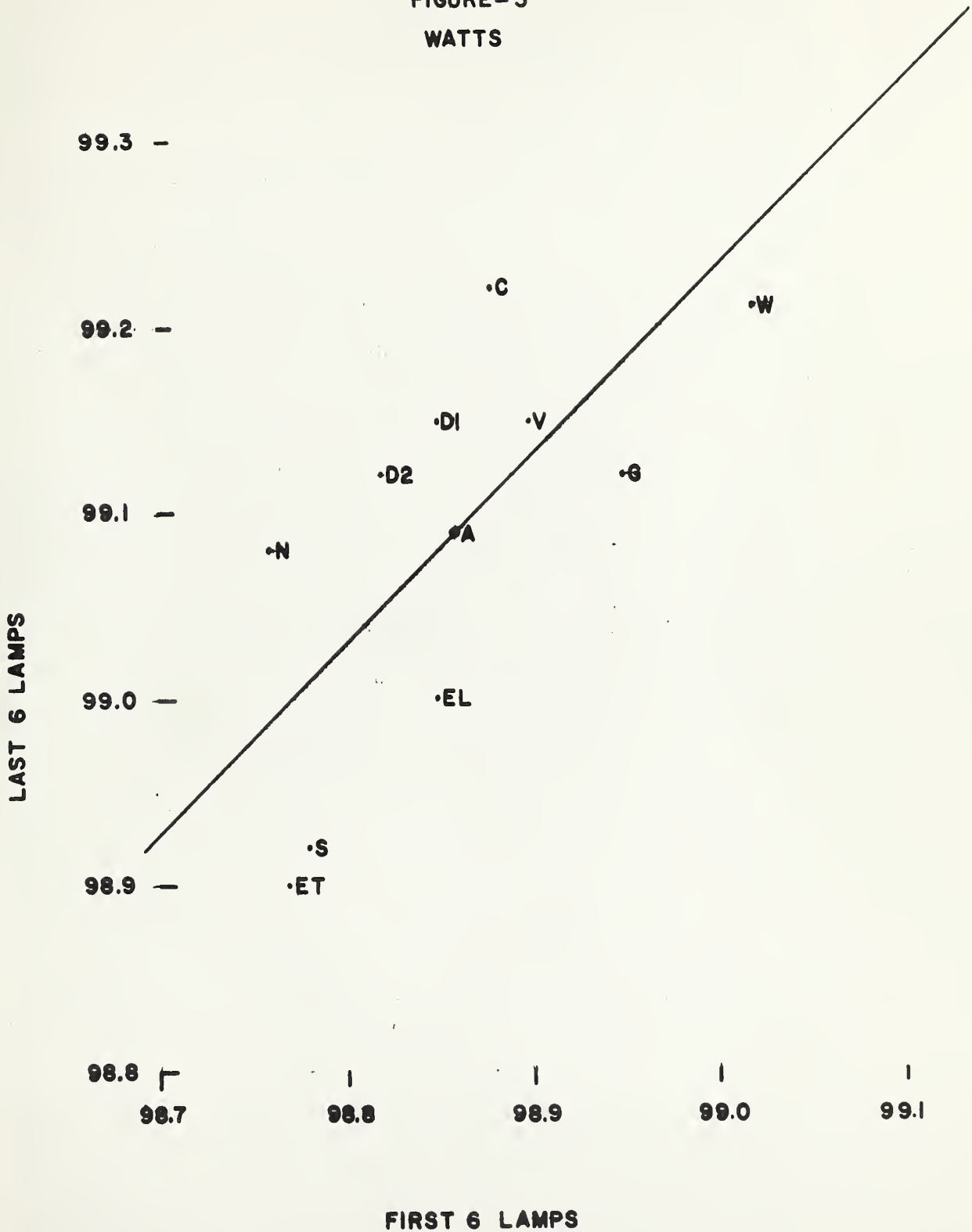




FIGURE - 4  
LUMENS PER WATT

